

Summary of EPA Recommendations

1. The FCC should not adopt the 1992 ANSI/IEEE standard. There are serious flaws in the standard that call into question whether the proposed use of 1992 ANSI/IEEE is sufficiently protective. The following four points address some of our concerns.

a) 1992 ANSI/IEEE allows a two-fold increase in the MPE at high frequencies above that permitted by the current FCC guideline.

b) The two-level revised standard is not directly applicable to any population group but is applicable to exposure environments called controlled and uncontrolled environments that are not well defined and are discretionary. We disagree with this approach.

c) The 1992 ANSI/IEEE conclusion that there is no scientific data indicating that certain subgroups of the population are more at risk than others is not supported by NCRP and EPA reports.

d) The thesis that the 1992 ANSI/IEEE recommendations are protective of all mechanisms of interaction is unwarranted because the adverse effects level in the 1992 ANSI/IEEE standard is based on a thermal effect.

2. The FCC should consider the exposure criteria recommended by the National Council on Radiation Protection and Measurements (NCRP) in NCRP Report No. 86, "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," with the addition of

(a) the 1992 ANSI/IEEE limits for induced and contact RF currents, for the frequency range of 300 kHz to 100 MHz, to protect against shock and burn, and

(b) the FCC proposal for low power device exclusions (FCC 93-142, pp. 7-8) as the standard for the public, where "public" includes all persons using these devices unless the user is operating a device as a concomitant of employment.

EPA recommends consideration of 1986 NCRP for the following reasons.

a) 1986 NCRP recommends RF radiation exposure limits specifically for both workers and the public.

b) 1986 NCRP is more protective than 1992 ANSI/IEEE at higher frequencies.

c) There are no substantive differences in the literature base supporting 1986 NCRP and 1992 ANSI/IEEE except for the literature on RF shocks and burns.

In addition, NCRP is chartered by the U.S. Congress to develop radiation protection recommendations.

3. The FCC should consider requesting that the NCRP revise its 1986 report to provide an updated, critical, and comprehensive review of the biological effects on RF radiation and recommendations for exposure criteria.

References

- EPA 1984. EPA-600/8-83-026F, Biological Effects of Radiofrequency Radiation, U.S. Environmental Protection Agency, September 1984.
- FCC 1993. Notice of Proposed Rulemaking; Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation, FCC 93-142, April 1993.
- FDA 1992. Current FDA Guidance for MR Patient Exposure and Considerations for the Future, T.W. Athey, In Biological Effects and Safety Aspects of Nuclear Magnetic Resonance Imaging and Spectroscopy, R.L. Magin, R.P. Liburdy and B. Persson, Editors, Annals of the New York Academy of Sciences 649: 242-257, 1992.
- IEC 1993. Medical Electrical Equipment, Part 2: Particular Requirements for the Safety of Magnetic Resonance Equipment for Medical Diagnosis, International Electrotechnical Commission (IEC), Sub-Committee 62B Standard (Draft), March 1993, 61 pages.
- IEEE 1991. IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, IEEE C95.1-1991, Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, NY 10017, April 27, 1992.
- IRPA 1991. Protection of the Patient Undergoing a Magnetic Resonance Examination, International Non-ionizing Radiation Committee of the International Radiation Protection Association (IRPA), Health Physics 61: 923-928, 1991.
- JHAPL 1984. APL Standard for Exposure to Radio-Frequency Radiation, APL Safety Memo No. 15, Johns Hopkins Applied Physics Laboratory, October 19, 1984.
- NCRP 1986. Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields, National Council on Radiation Protection and Measurements (NCRP), 7910 Woodmont Av, Bethesda, MD 20814, NCRP Report No. 86, April 2, 1986.
- NRPB 1992. Limits on Patient and Volunteer Exposure During Clinical Magnetic Resonance Diagnostic Procedures, In Biological Effects and Safety Aspects of Nuclear Magnetic Resonance Imaging and Spectroscopy, R.L. Magin, R.P. Liburdy and B. Persson, Editors, Annals of the New York Academy of Sciences 649: 376-398, 1992.
- NRPB 1993. Restrictions on Exposure to Static and Time-Varying Electromagnetic Fields and Radiation, National Radiological Protection Board (NRPB), Draft Proposal, March 1993, 14 pages.



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAR 27 1995

AIR & RADIATION
BRANCH

MAR 1 1995

OFFICE OF
AIR AND RADIATION

H. Patrick Wong
Chief Air Section
Environmental Resources Management
Environmental Monitoring Div., Suite 200
33 South West, 2nd Avenue
Miami, Florida 33130-1540

Dear Mr. Wong:

On February 3, 1995, you addressed a letter to the Environmental Protection Agency regarding possible health effects from cellular telephone base stations. This letter was referred to my office which has responsibility for Electromagnetic Fields (EMF) issues with the Environmental Protection Agency (EPA).

In order to address questions like yours concerning effects from exposure to non-ionizing radiation in the radiofrequency (RF) range, we have adopted a two phase approach. In Phase I, we are developing RF Exposure guidelines which will address previously identified health effects. Phase II involves working with the National Council on Radiation Protection and Measurements (NCRP) and to look at the consequences of widespread use of modulation upon existing exposure limit recommendations.

The RF Exposure Guidelines will be completed by the summer of 1995. Our approach is based upon existing health effects information and focuses upon well established health risks. The Guidelines of the NCRP, the Institute for Electrical and Electronics Engineering (IEEE), and the World Health Organization (WHO). This approach was first articulated in the comments EPA provided to the Federal Communications Commission (FCC) on that agency's Proposed Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation. To assist in this effort, EPA formed an interagency workgroup comprising the Food and Drug Administration (FDA), the FCC, the National Institutes of Occupational Safety and Health (NIOSH), the Occupational Safety and Health Administration (OSHA), and the National Telecommunications and Information Agency.

To address more problematic concerns such as the possible impact of modulation, EPA commissioned the NCRP to conduct a two-year study. The study will result in an official NCRP report focusing on the impact of modulation upon the use of specific absorption rates (SAR) as a



Recycled/Recyclable
Printed with Soy/Candela Ink on paper that
contains at least 50% recycled fiber

DAC

measure of dose. The NCRP report will provide the basis for revision of the RF Exposure Guidelines, if warranted. EPA will also closely follow other health effects research, particularly the efforts underway by the Science Advisory Group on Wireless Technology.

The concern in Dade County over cellular base stations is similar to questions we receive from throughout the United States. Typically, cellular telephone base stations have emission levels well below the levels addressed by RF Exposure Guidelines planned for summer of 1995. The Guidelines, as noted above, are based upon health effects identified at this time. EPA must await the outcome of the research efforts underway by NCRP and others before issues associated with any as yet unidentified health effects from cellular base stations can be effectively addressed.

Finally, your letter referred to "an on-going EPA study [that] has demonstrated ground level power density measurements well below the levels which might be expected to cause either thermal or non-thermal effects." EPA has not conducted any study which concluded that there is a level at which there cannot be any non-thermal effects, nor are we aware of any peer reviewed study which reach that conclusion. We do agree with your observation that cellular telephone base stations typical have a ground power density similar to or lower than other RF based technologies such as television and radio broadcast.

Sincerely,



E. Ramona Trovato, Director
Office of Radiation and Indoor Air

bcc: P. Wagner
D. O'Connor

ORLA:RSD:DOCONNOR:dh:02-22-95:6603J:x233-9340

Biological Effects of Microwave Radiation: A White Paper

The White Paper reproduced below was written by Dr. Cletus Kanavy, the chief of the biological effects group of the Phillips Laboratory's Electromagnetic Effects Division at Kirtland Air Force Base, NM, in October 1992. The references at the end of Kanavy's paper are omitted here.

The biological effects of microwave radiation on living organisms have been the subject of extensive research for the past four decades. The most comprehensive programs were conducted by the Soviet and Eastern Bloc nations. The U.S. has lagged behind badly in this area of research. Initially, the principal concern for human exposure to microwave radiation was that of thermal heating of the tissues. Permissive exposure limits were based on such criteria. Since the 1970s this limit has been progressively set at lower levels of average field power density for the classical six-minute time average period. These limits, which are published as the American National Standards Institute (ANSI) microwave standards, are actually derived by the Institute of Electrical and Electronics Engineers (IEEE). Under IEEE, a blue-ribbon panel of experts periodically reviews the research database and assesses the need to revise the standards. Until 1991, these standards did not consider the possible biological effects of "pulsed" microwaves. The 1991 standards do address the pulse condition (rather shabbily, I believe), place restrictions on the number of pulses per six-minute time period as a function of pulse width, and continue to use the continuous wave time averaging technique for thermal criteria. The existence of non-thermal effects is essentially denied by omission.

The U.S. research community was aware of the Soviet findings of deleterious biological effects at exposures well below the ANSI standards. The Soviet findings were rejected for various reasons. The principal reason was that U.S. attempts to duplicate the Soviet results were reportedly not successful. It was not until the mid-1980s that U.S. researchers began to successfully duplicate Soviet experimental results and began a research program to expand upon and further test the Soviet nonthermal theories.

Since March 1991, we have been conducting a comprehensive search of worldwide literature on the results of experimentation regarding biological effects produced by microwave radiation. The results of this search have been consolidated into a computerized database which we have shared with the Armed Forces Medical Intelligence Center and the Central Intelligence Agency. We attempted to share the database with the Armstrong Laboratory. A list of the holdings in the database was presented to Dr. Dave Erwin of Armstrong who proceeded to "line-out" the publications of researchers he believed not to be credible. These were researchers who were reporting the positive existence of nonthermal effects.

The literature published in the late 1980s is abundant with information on nonthermal effects which are produced at levels below the ANSI standards. These are essentially chronic exposure effects at low levels of average field power densities. Researchers

stress the chronic, nonthermal nature of these effects as opposed to acute exposure thermal effects. Ample experimental evidence exists from credible researchers from well-established and highly regarded institutions, both government and university, to justify a national research program into the full spectrum of biological effects of electromagnetic radiation.

The principal electromagnetic biological effects of greatest concern are behavioral aberrations, neural network perturbations, fetal (embryonic) tissue damage (inducing birth defect), cataractogenesis, altered blood chemistry, metabolic changes and suppression of the endocrine and immune systems. The verification of blood-brain barrier suppression should have a high priority. The passage of normal blood-borne toxins into the brain could explain some previously observed early behavioral aberrations, loss of physical endurance and functional central nervous system and perceptual changes. A large amount of data exists, both animal experimental and human clinical evidence, to support the existence of chronic, nonthermal effects. The Soviet studies of humans under occupational conditions report marked functional changes, sometimes accompanied by histological and biochemical changes, under the chronic influence of microwaves at power densities ranging from fractions of microwatts to a few milliwatts per square centimeter. Research to date has concentrated on determining the psychological/physiological effects (changes) produced by electromagnetic fields of various power densities, carrier frequencies and modulation rates. These results are the macroscopic part of the issue. The microscopic part of the issue urgently needs to be addressed—namely the physical mechanisms behind the various observed biological effects. Various theories and interaction models exist to explain, in a limited way, some of these physical mechanisms for specific effects. None have yet been positively verified. This is believed to be a key issue which needs to be addressed as soon as possible....

Other areas of concern center on the uninvestigated human response to high peak, low average power, moderate to high pulse repetition frequency microwave fields. The relationships between these variables and specific human responses should be of prime importance to the directed energy weapon (DEW) development programs. The ability of certain modulation frequencies imposed on various carrier frequencies to affect (lock onto) circadian rhythms poses a formidable research problem. A principal question raised is the existence of "frequency windows" and resonances associated with certain physiological and psychological responses. The past several issues of *Bioelectromagnetics* have contained many articles by prominent U.S. researchers which report nonthermal effects. New concerns are also forthcoming, i.e., bioeffects of ELF and electromagnetic fields in close proximity to high voltage power lines and transformer banks. Thus the entire issue of human interaction with electromagnetic (RF & microwave) radiation is pushing forward as a major national population health concern.

search program is to monitor the health of Kirtland employees exposed to RF/MW radiation. Erwin, however, rejects this idea. In his January letter to Godfrey, Erwin appended four different memos—one from an epidemiologist, one from a lawyer and two from members of his research group—to counter Kanavy's arguments for a long-term health monitoring program of high-power microwave workers at the Phillips Lab. He concluded that, "The consensus opinion is that such a limited program

would yield no legal or scientific benefit to the Air Force and might even have a negative impact."

Despite all the criticisms, Erwin's plan to consolidate all Department of Defense research on non-ionizing radiation is proceeding. The microwave lab at WRAIR has closed down and the equipment has been shipped to the Armstrong Lab. The Naval Aerospace Medical Research Lab in Pensacola, FL, is scheduled to move to San Antonio next summer.

Vol. #
18Use in
high-speed
telegraphic
data trans-
missions

brain. Prolonged exposure to low-level and low-frequency magnetic fields have been reported to increase the risk of developing leukemia, lymphoma, and brain cancer in children.

MICROWAVES

The microwave region extends from 1,000 to 300,000 MHz (or 30-centimetre to one-millimetre wavelengths). Although microwaves were first produced and studied in 1886 by Hertz, their practical application had to await the invention of suitable generators, such as the klystron and magnetron.

Microwaves are the principal carriers of high-speed telegraphic data transmissions between stations on the Earth and also between ground-based stations and satellites and space probes. A system of synchronous satellites about 36,000 kilometres above the Earth is used for international broadband telegraphy of all kinds of communications—e.g., television, telephone, and telefacsimile (FAX).

Microwave transmitters and receivers are parabolic dish antennas. They produce microwave beams whose spreading angle is proportional to the ratio of the wavelength of the constituent waves to the diameter of the dish. The beams can thus be directed like a searchlight. Radar beams consist of short pulses of microwaves. One can determine the distance of an airplane or ship by measuring the time it takes such a pulse to travel to the object and, after reflection, back to the radar dish antenna. Moreover, by making use of the change in frequency of the reflected wave pulse caused by the Doppler effect (see above), one can measure the speed of objects. Microwave radar is therefore widely used for guiding airplanes and vessels and for detecting speeding motorists. Microwaves can penetrate clouds of smoke, but are scattered by water droplets, and so are used for mapping meteorologic disturbances and in weather forecasting (see CLIMATE AND WEATHER: *Meteorological measurement and weather forecasting*).

Microwaves play an increasingly wide role in heating and cooking food. They are absorbed by water and fat in foodstuffs (e.g., in the tissue of meats) and produce heat from the inside. In most cases, this reduces the cooking time a hundredfold. Such dry objects as glass and ceramics, on the other hand, are not heated in the process, and metal foils are not penetrated at all.

The heating effect of microwaves destroys living tissue when the temperature of the tissue exceeds 43° C (109° F). Accordingly, exposure to intense microwaves in excess of 20 milliwatts of power per square centimetre of body surface is harmful. The lens of the human eye is particularly affected by waves with a frequency of 3,000 MHz, and repeated and extended exposure can result in cataracts. Radio waves and microwaves of far less power (microwatts per square centimetre) than the 10–20 milliwatts per square centimetre needed to produce heating in living tissue can have adverse effects on the electrochemical balance of the brain and the development of a fetus if these waves are modulated or pulsed at low frequencies between 5 and 100 hertz, which are of the same magnitude as brain wave frequencies.

Microwave
sources

Various types of microwave generators and amplifiers have been developed. Vacuum-tube devices, the klystron and the magnetron, continue to be used on a wide scale, especially for higher-power applications. Klystrons are primarily employed as amplifiers in radio relay systems and for dielectric heating, while magnetrons have been adopted for radar systems and microwave ovens (For a detailed discussion of these devices, see ELECTRONICS: *Principal devices and components Electron tubes*). Solid-state technology has yielded several devices capable of producing, amplifying, detecting, and controlling microwaves. Notable among these are the Gunn diode and the tunnel (or Esaki) diode. Another type of device, the maser (acronym for “microwave amplification by stimulated emission of radiation”) has proved useful in such areas as radio astronomy, microwave radiometry, and long-distance communications.

Astronomers have discovered what appears to be natural masers in some interstellar clouds. Observations of radio radiation from interstellar hydrogen (H₂) and certain other

molecules indicate amplification by the maser process. Also, as was mentioned above, microwave cosmic background radiation has been detected and is considered by many to be the remnant of the primeval fireball postulated by the big-bang cosmological model.

INFRARED RADIATION

Beyond the red end of the visible range but at frequencies higher than those of radar waves and microwaves is the infrared region of the electromagnetic spectrum, between frequencies of 10^{12} and 5×10^{14} Hz (or wavelengths from 0.1 to 7.5×10^{-3} centimetre). William Herschel, a German-born British musician and self-taught astronomer, discovered this form of radiation in 1800 by exploring, with the aid of a thermometer, sunlight dispersed into its colours by a glass prism. Infrared radiation is absorbed and emitted by the rotations and vibrations of chemically bonded atoms or groups of atoms and thus by many kinds of materials. For instance, window glass that is transparent to visible light absorbs infrared radiation by the vibration of its constituent atoms. Infrared radiation is strongly absorbed by water and by the atmosphere, as shown in Figures 3 and 5, respectively. Although invisible to the eye, infrared radiation can be detected as warmth by the skin. Nearly 50 percent of the Sun's radiant energy is emitted in the infrared region of the electromagnetic spectrum, with the rest primarily in the visible region.

Atmospheric haze and certain pollutants that scatter visible light are nearly transparent to parts of the infrared spectrum because the scattering efficiency increases with the fourth power of the frequency. Infrared photography of distant objects from the air takes advantage of this phenomenon. For the same reason, infrared astronomy enables researchers to observe cosmic objects through large clouds of interstellar dust that scatter infrared radiation substantially less than visible light. However, since water vapour, ozone, and carbon dioxide in the atmosphere absorb large parts of the infrared spectrum most infrared astronomical observations are carried out at high altitude by balloons, rockets, or spacecraft.

An infrared photograph of a landscape enhances objects according to their heat emission: blue sky and water appear nearly black, whereas green foliage and unexposed skin show up brightly. Infrared photography can reveal pathological tissue growths (thermography) and defects in electronic systems and circuits due to their increased emission of heat.

The infrared absorption and emission characteristics of molecules and materials yield important information about the size, shape, and chemical bonding of molecules and of atoms and ions in solids. The energies of rotation and vibration are quantized in all systems. The infrared radiation energy $h\nu$ emitted or absorbed by a given molecule or substance is therefore a measure of the difference of some of the internal energy states. These in turn are determined by the atomic weight and molecular bonding forces. For this reason, infrared spectroscopy is a powerful tool for determining the internal structure of molecules and substances or, when such information is already known and tabulated, for identifying the amounts of those species in a given sample. Infrared spectroscopic techniques are often used to determine the composition and hence the origin and age of archaeological specimens and for detecting forgeries of art and other objects, which, when inspected under visible light, resemble the originals.

Infrared radiation plays an important role in heat transfer and is integral to the so-called greenhouse effect (see above), influencing the thermal radiation budget of the Earth on a global scale and affecting nearly all biospheric activity. Virtually every object at the Earth's surface emits electromagnetic radiation primarily in the infrared region of the spectrum.

Man-made sources of infrared radiation include, besides hot objects, infrared light-emitting diodes (LEDs) and lasers. LEDs are small, inexpensive optoelectronic devices made of such semiconducting materials as gallium arsenide. Infrared LEDs are employed as optoisolators and as light sources in some fibre-optics-based communications systems (see ELECTRONICS: *Principal devices and compo-*

Conversion
of solar
energy into
electricityInfrared
LEDs and
lasers

F: SAC COMDI H1553CP.001

80

#6

1 of the failure of such cable operator or affiliate
2 thereof to obtain a franchise or franchise renewal
3 under this title with respect to the provision of such
4 telecommunications service.

5 "(D) A franchising authority may not require a cable
6 operator to provide any telecommunications service or fa-
7 cilities as a condition of the initial grant of a franchise
8 or a franchise renewal."

9 (b) FRANCHISE FEES.—Section 622(b) of the Com-
10 munications Act of 1934 (47 U.S.C. 542(b)) is amended
11 by inserting "to provide cable services" immediately before
12 the period at the end of the first sentence thereof.

→ 13 SEC. 107. FACILITIES SITING; RADIO FREQUENCY EMISSION
14 STANDARDS.

15 (a) NATIONAL WIRELESS TELECOMMUNICATIONS
16 SITING POLICY.—Section 332(c) of the Communications
17 Act of 1934 (47 U.S.C. 332(c)) is amended by adding at
18 the end the following new paragraph:

19 "(8)(A) Within 180 days after enactment of this
20 paragraph, the Commission shall prescribe and make ef-
21 fective a policy regarding State and local regulation of the
22 placement, construction, modification, or operation of fa-
23 cilities for the provision of commercial mobile services.

24 "(B) Pursuant to subchapter III of chapter 5, title
25 5, United States Code, the Commission shall establish a

There
should
be
local
zoning
control

NO

1 negotiated rulemaking committee to negotiate and develop
2 a proposed policy to comply with the requirements of this
3 paragraph. Such committee shall include representatives
4 from State and local governments, affected industries, and
5 public safety agencies. In negotiating and developing such
6 a policy, the committee shall take into account—

7 “(i) the desirability of enhancing the coverage
8 and quality of commercial mobile services and foster-
9 ing competition in the provision of such services;

10 “(ii) the legitimate interests of State and local
11 governments in matters of exclusively local concern;

12 “(iii) the effect of State and local regulation of
13 facilities siting on interstate commerce; and

14 “(iv) the administrative costs to State and local
15 governments of reviewing requests for authorization
16 to locate facilities for the provision of commercial
17 mobile services.

18 “(C) The policy prescribed pursuant to this para-
19 graph shall ensure that—

20 “(i) regulation of the placement, construction,
21 and modification of facilities for the provision of
22 commercial mobile services by any State or local
23 government or instrumentality thereof—

24 “(I) is reasonable, nondiscriminatory, and
25 limited to the minimum necessary to accomplish

1 the State or local government's legitimate pur-
2 poses; and

3 "(II), does not prohibit or have the effect
4 of precluding any commercial mobile service;
5 and

6 "(ii) a State or local government or instrumen-
7 tality thereof shall act on any request for authoriza-
8 tion to locate, construct, modify, or operate facilities
9 for the provision of commercial mobile services with-
10 in a reasonable period of time after the request is
11 fully filed with such government or instrumentality;
12 and

13 "(iii) any decision by a State or local govern-
14 ment or instrumentality thereof to deny a request
15 for authorization to locate, construct, modify, or op-
16 erate facilities for the provision of commercial mobile
17 services shall be in writing and shall be supported by
18 substantial evidence contained in a written record.

19 "(D) The policy prescribed pursuant to this para-
20 graph shall provide that no State or local government or
21 any instrumentality thereof may regulate the placement,
22 construction, modification, or operation of such facilities
23 on the basis of the environmental effects of radio fre-
24 quency emissions, to the extent that such facilities comply

NO!
There
should
be
local
option
for
N.D.F.E.
Protective
standards

F: SAC: D: 2233CP.001

W

83

1 ~~With~~ the Commission's regulations concerning such emis-

2 ~~ions.~~

3 (a) In accordance with subchapter III of chapter

4 5 title 5 United States Code, the Commission shall peri-

5 ~~ennially~~ establish a negotiated rulemaking committee to

6 ~~review~~ the policy prescribed by the Commission under this

7 paragraph and to recommend revisions to such policy."

8 (b) RADIO FREQUENCY EMISSIONS.—Within 180

9 days after the enactment of this Act, the Commission shall

10 complete action in ET Docket 93-62 to prescribe and

11 make effective rules regarding the environmental effects

12 of radio frequency emissions.

13 (c) AVAILABILITY OF PROPERTY.—Within 180 days

14 of the enactment of this Act, the Commission shall pre-

15 scribe procedures by which Federal departments and agen-

16 ~~cies~~ may make available on a fair, reasonable, and non-

17 discriminatory basis, property, rights-of-way, and ease-

18 ~~ments~~ under their control for the placement of new tele-

19 communications facilities by duly licensed providers of

20 telecommunications services that are dependent, in whole

21 or in part, upon the utilization of Federal spectrum rights

22 for the transmission or reception of such services. These

23 procedures may establish a presumption that requests for

24 the use of property, rights-of-way, and easements by duly

25 authorized providers should be granted absent unavoidable

This is
the ANSI 199:
standard
which the
EPA
advised
AGAINST
adopting
(see Marago
Oge letter
of Nov 93)

ANSI
Yes.

F: SAC -)

- 1 direct conflict with the department or agency's mission.
- 2 for the current or planned use of the property, rights-of-
- 3 way, and easements in question. Reasonable cost-based
- 4 fees may be charged to providers of such telecommuni-

but
fair
not
Vd

H.L.C.

AMENDMENT TO H.R. 1555, AS REPORTED
OFFERED BY MR. MORAN OF VIRGINIA

[Facilities Siting]

(Page & line nos. refer to Bill as Reported by the Commerce
Committee)

Page 90, beginning on line 11, strike paragraph (7)
through page 93, line 6, and insert the following:

1 “(7) FACILITIES SITING.—(A) Except as pro-
2 vided in subparagraph (B), the Commission shall be
3 prohibited from engaging in any rulemaking that
4 preempts or has the effect of preempting State or
5 local regulation of the placement, construction,
6 modification, or operation of facilities for the provi-
7 sion of commercial mobile services.

8 “(B) No State or local government or any in-
9 strumentality thereof may regulate the placement,
10 construction, modification, or operation of such fa-
11 cilities on the basis of the environmental effects of
12 radio frequency emissions, to the extent that such
13 facilities comply with the Commission’s regulations
14 concerning such emissions.

15 “(C) A State or local government or any instru-
16 mentality thereof may regulate the placement, con-

Not
Acceptal

Local
Jurisdiction
should
be
free
to set

more
protective
standard

1 construction, modification, or operation of such facilities
2 if—

3 (i) the regulation of the placement, con-
4 struction, and modification of facilities for the
5 provision of commercial mobile services by any
6 State or local government or instrumentality
7 thereof—

8 “(I) is reasonable, does not discrimi-
9 nate among commercial mobile service pro-
10 viders, and is limited to the minimum nec-
11 essary to accomplish the State or local gov-
12 ernment's legitimate purposes; and

13 “(II) does not prohibit or have the ef-
14 fect of precluding any commercial mobile
15 service; and

16 “(ii) a State or local government or instru-
17 mentality thereof acts on any request for au-
18 thorization to locate, construct, modify, or oper-
19 ate facilities for the provision of commercial
20 mobile services within a reasonable period of
21 time after the request is fully filed with such
22 government or instrumentality; and

23 “(iii) any decision by a State or local gov-
24 ernment or instrumentality thereof to deny a
25 request for authorization to locate, construct,

Shall be the
same as
Zoning
for any
other
structure
Local
Jurisdiction
decision.

1 modify, or operate facilities for the provision of
2 commercial mobile services is in writing and is
3 supported by substantial evidence contained in
4 a written record.

5 “(D) Any person adversely affected by any final
6 determination made by a State or local government
7 or any instrumentality thereof under this paragraph
8 shall commence an action within 120 days after re-
9 ceiving such determination in (i) the district court of
10 the United States for any judicial district in which
11 the instrumentality is located; or (2) in any State
12 court of general jurisdiction having jurisdiction over
13 the parties.”.

#7

POTENTIAL AND ACTUAL ADVERSE EFFECTS OF CELLSITE MICROWAVE RADIATION

Dr Neil Cherry

Director
Climate Research Unit
P.O. Box 84, Lincoln University *Christchurch, New Zealand*
Ph: (03) 325 3828 Fax (03) 325 3845
E-mail: CHERRY@KEA.Lincoln.ac.nz

17th April 1995

1. INTRODUCTION

1.1 The Context

Many people have expressed concerns about the actual or potential adverse health effects of living or working near a cellsite mast which is continuously radiating very low levels of modulated microwave radiation.

While the telecommunication companies and the National Radiation Laboratory staff frequently say that there are no known human health effects below the New Zealand Standard NZS 6609 of $200 \mu\text{W}/\text{cm}^2$ ($2 \text{ W}/\text{m}^2$) because there are no known or proven athermal effects (effects other than heating), the evidence set out in this report is convincing that there are potential and actual effects at well below the New Zealand "safety" standard for microwaves.

This report uses only peer-reviewed published information or unpublished information which I have checked out with the author who has carried out the research. Where possible too, I have checked the credibility and reputation of the international researchers with highly qualified professionals in New Zealand.

This report is dated so that you can be aware of the latest revision of the information which I am receiving and analysing and discard previous reports with earlier dates.

1.2 Background, Experience and Personal Context:

In addressing the actual and potential effects on human health of cellsites I bring the following background, expertise and experience:

- a. I am a Canterbury Regional Councillor.
- b. I hold the degree of Bachelor of Science with Honours in Physics, specializing in solid state physics and electron spin resonance spectrum changes with exposure to microwaves, from the University of Canterbury (1969).
- c. I hold the degree of Doctor of Philosophy in Physics, specializing in atmospheric lee waves, a resonance phenomenon of the atmosphere studied using weather radar (1971).
- d. I am a professional member of the following learned and professional societies:
 - Fellow of the Royal Meteorological Society (F.R.Met.S.)
 - Professional Member of the American Meteorological Society (M.Am.Met.S.)
 - Member of the Royal Society of New Zealand (M.R.S.N.Z)
 - Member of the International Society of Environmental Epidemiology (I.S.E.E.).

Page 2 & 3 missing

Section 3 sets out the meaning of "effect":

In this Act, unless the context otherwise requires, the term "effect" includes -

- (a) Any positive or negative effect; and
- (b) Any temporary or permanent effect; and
- (c) Any past, present or future effect; and
- (d) Any cumulative effect which arises over time or in combination with other effects -

regardless of the scale, intensity, duration, or frequency of the effect, and also includes -

- (e) Any potential effect of high probability; and
- (f) Any potential effect of low probability which has a high potential impact.

Section 17 extends the DUTY to deal with adverse effects to everyone:

Section 17. Duty to avoid, remedy, or mitigate adverse effects -

- (1) Every person has a duty to avoid, remedy, or mitigate adverse effect on the environment arising from an activity carried on by or on behalf of that person, whether the activity is in accordance with a rule in a plan, a resource consent [Section 10, section 10A or section 20].
- (2) The duty referred to in subsection (1) is not of itself enforceable against any person, and no person is liable to any other person for a breach of that duty.
- (3) Notwithstanding subsection (2), an enforcement order or abatement notice may be made or served under Part XII to -
 - (a) Require a person to cease, or prohibit a person from commencing, anything that, in the opinion of the Planning Tribunal or an enforcement officer, is or is likely to be noxious, dangerous, offensive or objectionable to such an extent that it has or is likely to have an adverse effect on the environment or
 - (b) Require a person to do something that, in the opinion of the Planning Tribunal or an enforcement officer, is necessary to avoid, remedy or mitigate any actual or likely adverse effects on the environment caused by, or on behalf of, that person.
- (4) Subsection (3) is subject to section 319(2) (which specifies when a Planning Tribunal shall not make an enforcement order).

Section 15 regulates discharges of contaminants:

Section 15 Discharge of contaminants into environment -

- (1) No person may discharge any -
 - (a) Contaminant into water; or
 - (b) Contaminant onto or into land in circumstances which may result in that contaminant (or any other contaminant emanating as a result of natural processes from that contaminant) entering water; or

- (c) Contaminant from any industrial or trade premises into air; or
- (d) Contaminant from any industrial or trade premises onto or into land -

unless the discharge is expressly allowed by a rule (in a regional plan or in any relevant proposed regional plan), a resource consent, or regulations.

- (2) No person may discharge any contaminant into air, or onto or into land, from -
 - (a) Any place; or
 - (b) Any other source, whether moveable or not, -

in a manner that contravenes a rule in a regional plan or proposed regional plan unless the discharge is expressly allowed by a resource consent or allowed by section 20 (certain existing lawful activities allowed).

Section 2(1) defines what is a "contaminant":

Section 2(1) "Contaminant"

In this Act, unless the context otherwise requires, -

includes any substance (including gases, liquids, solids and micro-organisms) or energy (excluding noise) or heat, that either by itself or in combination with the same, similar or other substances, energy or heat -

- (a) When discharged into water, changes or is likely to change the physical, chemical or biological condition of the water; or
- (b) When discharged onto or into land, or into air, changes or is likely to change the physical, chemical or biological condition of the land or air onto or into which it is discharged.

2. THE RESOURCE MANAGEMENT ACT (1991) when applied to the radiation of microwaves from a cellsite.

Microwaves radiated into the environment from a cellsite are a 'contaminant' under the definitions in the RMA since they are a form of energy which "changes or is likely to change the physical, chemical or biological condition of the land or air onto or into which it is discharged."

A cellsite is a "trade premise" and therefore no person may discharge a contaminant from it "unless allowed by a rule (in a regional plan or any relevant proposed regional plan), a resource consent, or regulations." Note that a District or City Council structural resource consent is a separate issue. As yet no Regional Councils have a plan or policy to identify transmitted microwaves or radiofrequencies as contaminants into the air. Contaminants which are controlled are listed in the schedules of the the Clean Air Act which are still in force as transitional plans are yet to be replaced by Regional Air Management Plans prepared by Regional Councils under the Resource Management Act (1991).

If it can be shown that cellsite microwave radiation does, is likely to, or has the potential to, cause an adverse effect on the environment (including people and communities) and/or that in adversely affecting the health (life-supporting capacity of) of people, communities or flora and fauna, having either a temporary or permanent effect, either by themselves or in combination with other effects, regardless of the scale, intensity, duration or frequency of the effect, then they will be in breach of the RMA section 5(2). Section 17 will also apply.

As microwave radiation is a contaminant, it has the potential to be included in the Regional Air Management Plan if it is an issue of significant public concern and/or they are shown to have actual or potential adverse effects on people and the environment. It is also becoming recognised that the absence of conclusive scientific proof of the scope and impact of a potential adverse environmental effect should not be a reason to delay avoidance or mitigation. This is called "The Precautionary Principle" which, in the case of cellsite microwave radiation, suggests the application of minimal exposure and prudent avoidance, especially for the very young, child-bearing women and the elderly. The possibility of testicular cancer might also suggest that this be applied to men.

If the Precautionary Principle had been applied to the problem of Ozone Depletion and ultraviolet radiation induced skin cancer and eye damage, action of phasing out CFC's would have been required to commence before about 1978. As it was, industrial and political pressure delayed this until the late 1980's, allowing millions of tonnes of CFCs to be released into the stratosphere to affect UV levels well into next century.

3. THE PRECAUTIONARY PRINCIPLE:

In adopting Agenda 21 and ratifying the Framework Convention on Climate Change, the New Zealand Government has a legal imperative to adopt the Precautionary Principle in matters relating to the environment. Hence in the Government's "Environment 2010 Strategy" it includes principles to guide the strategy, including Principle 10:

"Principle 10: The precautionary Principle

The Precautionary Principle should guide decision-makers when confronted by threats of serious or irreversible environmental damage; that is, the lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

This principle recognises that:

- * One of the major challenges of environmental management is to make good decisions under uncertainty or inadequate information. This recognises the variety of perceptions of people. It also acknowledges the difficulties of precise definition of sustainable ecological limits.
- * Principle 15 of the Rio Declaration on Environment and Development states that, in order to protect the environment, the precautionary approach should be widely applied. "Where there are threats of serious irreversible damage, lack of scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."

The World Health Organisation (WHO) in 1981 issued its report "Environmental Health Criteria 16: Radiofrequency and Microwaves" and in part concludes:

"Effects have been reported at power densities too low to produce biologically significant heating."

and

"The general population includes persons of different ages (infants, small children, young adults and senior citizens) and different states of health, including pregnant women. The possible greater susceptibility of the developing foetus to microwave/RF exposure may deserve special consideration. Exposure of the general population should be kept as low as possible and limits should generally be lower than for occupational exposure.

In view of the fact that data are still required to clarify interaction mechanisms and determine threshold levels for effects, it is recommended that microwave and RF exposure of occupationally-exposed workers and the general population should be kept as low as readily achievable."

It is sobering to note that in 1981, toxicology texts were also unconcerned about malignant skin cancers from UV exposure. Hence the WHO report on microwave/RF effects, if coupled with the Precautionary Principle as it is becoming to be applied now, would have led the government, regional and district councils, to adopt policies for the siting of cellsites away from places where children and women of child-bearing age would reside and/or work. For example, cellsites would not be located in or near schools, playcentres, kindergartens and daycare centres, nor near residences or workplaces where women of child-bearing age worked.

The reality in New Zealand is that no thought has been given to the potential or actual adverse effects of cellsites until recently since they are at such low power densities that they cannot produce thermal effects, and non-thermal effects are ignored or dismissed and impossible by the telecommunications industry, the Standards Committee and the National Radiation Laboratory (NRL).

The official position of the NRL is, the $200\mu\text{W}/\text{cm}^2$ (0.08 W/kg) is so far below the level at which heating effects are detectable $10,000\mu\text{W}/\text{cm}^2$ (4 W/kg) that there can be no adverse health effects.

This report sets out information to challenge the certainty and validity of this position.

5. RECENT RESEARCH, POST 1993

5.1 Research Approach:

In approaching this recent research I have taken the approach of proposing common claims or recent findings as hypotheses to be tested against the latest published, peer-reviewed papers and reports, and conversations and correspondence with the researchers themselves.

5.2 Introduction

Claims of no known athermal health effects from microwaves have been made by Professor Phil Butler and Dr Colin Hooker, Physics Department, University of Canterbury, CTV Thursday 9th March 1995 and in public hearings and public meetings by the staff of the National Radiation Laboratory.

In my follow up conversation with Professor Butler he outlined his understanding that at very high levels of exposure to microwave there was rapid death, at moderately high levels burning occurs, and at still lower levels (above about 4 W/kg) body heating effects occur at a rate for which the human body can lose heat with no adverse thermal effects. He reiterated his conviction that below this level there were no known and documented adverse health effects. This is also the position of the staff of the National Radiation Laboratory, who are very cynical about the ability of epidemiology to properly identify and quantify the subtle statistical population-based responses to very low levels of electromagnetic radiation exposure involved with TV masts at distances of km from the mast, and cellsite towers at distances of 100's of metres from the transmitter.

I agree with much of the substance of the opinions expressed by my skeptical colleagues but I view the evidence on potential and actual adverse health effects with more concern than they do. I approach the question from quite a different perspective. I have had long experience in dealing with inferred and actual health effects from air pollution contaminants and spent many years researching into the effects of weather on people.

This is now being applied through my growing experience of consent hearings and assessment of environmental effects as a Regional Councillor. In this situation the Resource Management Act (1991), through careful consideration of actual and potential adverse effects on the environment, including small, cumulative effects, increasingly involves the application of the "precautionary principle" so that health of the environment, including people, is not put at unnecessary and avoidable risk through the lack of scientific certainty.

In the case of microwaves from cell sites, if a reasonable doubt can be raised about the absolute safety of the cell sites, through a reasonable interpretation of physical processes and published, peer-reviewed literature which demonstrates the real possibility of adverse health effects of microwave exposure at very low intensities but accumulated to more significant doses over time, then the precautionary principle becomes vital. In this case it suggests the application of prudent avoidance, through a minimum practical exposure in such a way, that the uncertainties and fears of the population of residents, parents and pupils in close proximity to cell sites can be alleviated while allowing cell sites to be established subject to the agreed "prudent avoidance/minimum exposure" criteria.

I set out here a case which I strongly believe establishes the potential for significant adverse health effects from low intensity but accumulated dosage over time when in close proximity to a microwave source, particularly if the microwaves are pulsed as in the cell site case, with considerable evidence for actual effects. I develop plausible physical processes for the interaction of pulsed microwaves with the human body and present internationally published, peer-reviewed studies, which when taken together, form strong evidence of the range and types of adverse health effects which are observed in association with low level microwave exposure and could well be caused by it.

6. HYPOTHESIS 1: No conceivable effect below the heating threshold.

Hypothesis 1: "There is no conceivable effect of electromagnetic radiation in the microwave region apart from heating effects at levels above 4 W/kg."

6.1 The electromagnetic spectrum:

The electromagnetic spectrum spans wavelengths which are so short that they are particles, through X-rays and Gamma-rays, ultraviolet, visible and infrared radiation, microwaves, shortwave and long-wave radiation. Figure 1 shows the wavelengths associated with the recognised parts of the em-spectrum, along with the atomic and molecular changes which are produced by the various parts of the spectrum which are used in Molecular Spectroscopy to identify what atoms or molecules are present in a sample.

We know that the interaction of electromagnetic (EM) radiation with physical and biological substances is strongly dependent on the wavelength of the EM radiation and the intensity of that radiation. EM radiation exists in discrete energy packets called photons, having energy $h\nu$, where h is Planck's constant and ν is the frequency of the radiation. If there is a natural energy state change in the receiving medium which corresponds to the energy in a photon of EM radiation then strong absorption will take place as a form of resonant absorption.

6.2 Ionising Radiation:

We know that ionising radiation which releases high energy electrons, photons or alpha particles damages human cells and DNA, producing cell mutations, reducing the effectiveness of the body's immune system and generating many types of cancers. The particles involved have a zero "wavelength" and very high energy intensities. They penetrate the human body with ease and damage cells deep in body tissue by their sheer impact energy.

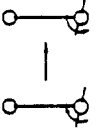
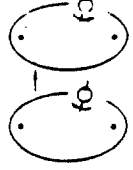
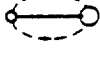
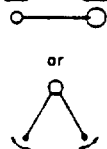


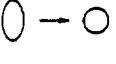
Change of spin		Change of orientation	Change of configuration	Change of electron distribution		Change of nuclear configuration
N.m.r.	E.s.r.	Microwave	Infra-red	Visible and ultra-violet	X-ray	γ-ray
						
10^{-12}	1	100	10^4	10^6	10^8	10^{10}
10 m	100 cm	1 cm	100 μm	1 μm	10 nm	100 pm
3×10^8	3×10^9	3×10^{10}	3×10^{12}	3×10^{14}	3×10^{16}	3×10^{18}
10^{-12}	10^{-11}	10	10^4	10^5	10^7	10^9
				joules/mole	Energy	

Figure 1: Electromagnetic Spectrum as used for Molecular Spectroscopy,

6.3 Xrays and Gamma rays

Gamma Rays and Xrays have progressively longer wavelengths up to about $0.1 \mu\text{m}$ (μm = millionths of a metre). Gamma Rays emitted from nuclear waste is known to be carcinogenic. They have energies in the order of several hundred thousand electronvolts. The softer Xrays have good medical uses but we have learned to use them with great care. This is especially so with pregnant women and children, because of the potential and actual damage which Xrays can do to body tissue. Minimum exposure is the clinical practice now whereas a few decades ago shoe shops had Xray machines to help to fit shoes.

6.4 Ultraviolet Radiation:

At slightly longer wavelengths we encounter ultraviolet radiation ($0.1 \mu\text{m}$ to $0.4 \mu\text{m}$). There is widespread understanding and awareness now that a particular part of the UV spectrum, UVC ($0.1 \mu\text{m}$ to $0.28 \mu\text{m}$) and UVB (0.28 to $0.315 \mu\text{m}$), causes immune system damage and many forms of skin and eye damage, including several forms of skin cancer, ranging from benign to fatal. The majority of the solar UV radiation is absorbed in the Ozone Layer, making terrestrial organic life possible. Almost all of the extremely harmful UVC is absorbed by the ozone layer, while about 90 % of the very harmful UVB is absorbed. This leaves the remaining 10 % of this narrow band to produce the observed health problems, i.e. 2 W/m^2 near noon on a summers day ($200 \mu\text{W/cm}^2$). The ability of UV to cause skin changes is related to the "erythermal effectiveness". When the variable ability of skin to respond at different UV wavelengths is included then the typical erythermal weighted UV irradiance at Lauder, New Zealand for noon in summer is (when corrected) $29.2 \mu\text{W/cm}^2$ from McKenzie, Matthews and Johnson (1991) and Richard McKenzie (pers.comm.).

Thus UV levels at and below $200 \mu\text{W}/\text{cm}^2$ are responsible for sunburn, skin damage and skin cancer. While few, if any, doctors in New Zealand would consider summer, midday UV exposure to be safe in 1995. In 1983 Hamilton and Hardy's "Industrial Toxicology" acknowledges that "Skin and eyes are very susceptible to damage from ultraviolet radiation." but concludes "A light layer of clothing will eliminate all wavelengths from reaching the skin. This weak penetration ability limits the usefulness of ultraviolet radiation as a bactericidal or viricidal agent, but it also allows the human body to protect itself from ultraviolet radiation except for superficial effects." - There is no mention of malignant skin cancer and it pre-dates our current understanding of how little protection most summer clothing affords against the penetration and burning effects of UV.

In the last 10 to 15 years our appreciation of the damaging effects of UV exposure has grown and the data shows that around 300 people die each year in New Zealand from malignant skin cancers, primarily melanoma.

6.5 Visible light:

Visible light ($0.4\mu\text{m}$ to $0.7\mu\text{m}$) interacts with the molecules of the atmosphere by exciting electrons to higher energy levels. Particular wavelengths, especially around the middle of the spectrum (green), produce photosynthesis and begins the food chain.

6.6 Infrared (Thermal) Radiation:

Infrared radiation ($0.7\mu\text{m}$ - $100\mu\text{m}$) interacts with particular molecules in the atmosphere, experiencing very strong absorption at those particular wavelengths which have an energy that matches a vibration or rotation state of the gas molecules. These are known as natural "greenhouse" gases. They produce temperatures on the surface of the earth which makes life possible.

6.7 Microwave radiation:

Beyond the far infrared part of the spectrum the wavelengths between about 1 mm and 1 m are called microwaves. The Specific Absorption Rate (SAR) (W/kg) of microwaves is strongly dependent on the match between the wavelength of the microwaves and the size of the objects they encounter. The following Figure 2, shows a theoretical calculation of the SAR for three objects "Man, Monkey and Mouse".

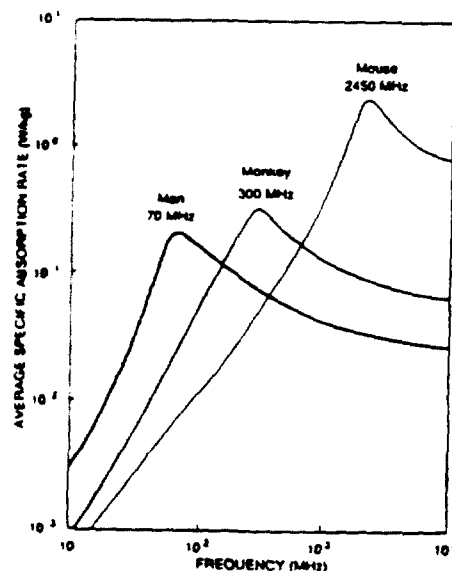


Figure 2: Average SAR for 3 species exposed to $10 \text{ W}/\text{m}^2$, with the E-vector parallel to the long axis of the body. From Durney et.al. (1978).

This shows a rather "soft" resonance effect compared to the strong, wavelength specific resonant absorption of UVB and the infrared/greenhouse gas interaction. "Man" peaks at 70 MHz (MHz=million cycles per second), "Monkey" at 300 MHz and "Mouse" at 2,450 MHz. The wavelengths of the microwaves are 4.3 m, 1 m and 12 cm respectively. This suggests that absorption is strongest when the size of the object is about one half of the wavelength. This theoretical calculation also shows why microwave ovens use 2450 MHz to cook vegetables and chickens. This corresponds to radiowaves which use half-wave dipoles as aerials to pick up signals. A 6 m aerial is good to pick up the 12 m shortwave broadcast band.

It also shows that children absorb microwave radiation more strongly at a higher frequency and shorter wavelength than adults. At a cellsite frequency of 800 MHz to 900 MHz the monkey (approximating a small child) absorbs about 3.3 times as much power per kg than an adult (Man), noting the logarithmic scale.

While in common usage microwaves are used for heating and cooking, in molecular spectroscopy, Figure 1, the ability of microwaves to change the orientation of simple and complex molecules is used for identifying the molecules. This raises the question as to what levels of power density would be required to re-align some key molecules in human cells or human brains in such a manner that the reactions are altered significantly.

Cellsite signals are in the 800 to 900 MHz range, away from the optimum absorption frequency for "Man" but somewhat closer to the "Monkey" or "Child" or "arm" or "head" optimum. With 800 MHz having a wavelength of 37.5 cm, its optimum absorption will take place for objects with dimensions around 18.8 cm, and 900 MHz around 16.7 cm.

6.8 Animal Experiments at levels below the "Heating Threshold":

The WHO report "Environmental Health Criteria 137: Electromagnetic fields, 1993 reports significant effects when body temperatures of animals are raised by exposure to RF fields, results are less clear for exposure levels below the heating threshold. However it does conclude:

"Most animal data suggest that low RF exposure does not raise body temperatures above the normal physiological range is not mutagenic; thus such exposure will not result in somatic mutation or hereditary effects."

and

"A substantial body of data exists describing in vitro biological responses to amplitude-modulated RF radiation too low to involve any response to heating. Some studies have reported effects after exposure at SARs of less than 0.01 W/kg, occurring within the modulation frequency 'windows' (usually between 1 and 100 Hz) and sometimes within power density 'windows'.

Changes have been reported in the electroencephalograms of cats and rabbits, in calcium mobility in the brain tissue in vitro and in vivo, in lymphocyte cytotoxicity in vitro and in the in vivo activity of an enzyme involved in cell growth and division."

The report states further that it is important that these studies be validated.

Servantie (1989) summaries criteria of microwave exposure and includes discussion of the results of experiments with animals. He states "There is no reason some of the RF biological effects in animals could not be found in humans if biological mechanisms involved are not specific to the experimental animal." This has been confirmed by personal communication with Professor Beale in relation to blood chemistry, brain function, neurohormones, cardiovascular system and reproductive systems, etc which have very similar physiology throughout mammals

6.9 Conclusion:

It has been shown that children and body organs at around 16 to 18 cm in dimension, are stronger absorbers of microwaves than are larger objects, that microwaves do change the molecular orientation of asymmetric molecules and that there are animal experiments which show biological effects in animals brains and at the cell chemistry level. Other results presented below show epidemiological studies and laboratory studies which identify similar effects in humans.

This information negates the hypothesis and suggests that a potential resonant absorption region does exist for human bodies and body parts in the microwave region of the EM spectrum.

7. HYPOTHESIS 2: Ultraviolet Radiation Comparison

Hypothesis 2: "Even though it is now known that solar UV radiation produces eye and skin damage, including melanoma, microwave intensities at the New Zealand standard for residential safety are so much lower than this that no health effects are possible."

This is negated when it is recognised that although the solar UV is about 10 % of the total solar spectrum at the top of the atmosphere, where the solar intensity is about 1370 W/m^2 , most of the UV is absorbed in the Ozone Layer. Tissue damage is primarily caused by the 10 % remnant of UVB in the centre of the UV part of the spectrum. This has a mean intensity on a typical summer day, during the hot, burning mid-day period, of about 2 W/m^2 , or $200 \mu\text{W/cm}^2$. This is equal to the New Zealand residential microwave standard and corresponds to an SAR of 0.08 W/kg . Erythral weighted exposure to UV associated with skin change occurs at a value of around $29 \mu\text{W/cm}^2$.

8. HYPOTHESIS 3: Human health effects below $200 \mu\text{W/cm}^2$

Hypothesis 3: "There is no reliable evidence of human health effects for microwave exposures below the New Zealand Standard NZ 6609 for residential exposure ($200 \mu\text{W/sq.cm.} = 0.08 \text{ W/kg}$)."

8.1 Epidemiological Studies:

The search for reliable and significant statistical relationships concerning low level exposures of contaminants over large populations is the task of Epidemiologists. The population is assaulted and stressed by many factors relating to contaminants in the environment, not the least being smoking. Hence the search of public health data-bases and their comparison with single or multiple stress factors must be undertaken with care and skill.

Epidemiological studies have been very successful in detecting many sources of human cancer, many years before the actual cause and effect relationships have been identified. This has been illustrated in this report in relation to melanoma and UV radiation.

Given care and skill, and extensive in-depth studies, some clear results and conclusions can be drawn from epidemiological investigations. New Zealand is fortunate in the quality and calibre of our epidemiological profession. For example, the standard text on epidemiology was written by Associate Professor Neil Pearce of the Wellington Clinical School and published by Oxford University Press.

Some areas of investigation pose particular difficulties because nobody has thought to request or fund the collection of data and samples. This is the case with cellsites. Cellsites produce very low levels of microwave radiation but throughout the country and the world. They will expose millions of people to levels around 0.01 to $1 \mu\text{W/sq.cm}$, which are more than 10 to 1000 times higher than EM levels found in rural areas of New Zealand.